

Observations on the Gland-like Bodies in the *Bryozoa*.

By ARTHUR W. M. WATERS, F.L.S., F.G.S.

[Read 7th April, 1892.]

(PLATE XIX.)

IN my Supplementary Report on the *Polyzoa* collected by H.M.S. 'Challenger'*, I referred (p. 27) to certain gland-like bodies † occurring in a large number of species, and also to sacs difficult to explain in the avicularian chamber of *Lepralia margaritifera*, Quoy and Gaimard. It happened that the 'Challenger' material of the species in which these structures were noticed was not at all satisfactory for their exact study, nor would the time allowed me for my work have permitted of many preparations. I have therefore since cut sections of all my available species, and as several new points have turned up it seems best now to publish my results even though they cannot be looked upon as complete, for I have not yet been able to trace the early stages of these structures; on the other hand, there seems reason for considering that the suboral and avicularian glands must be considered as homologous.

The sections were mostly cut from specimens obtained from Naples and preserved in spirit many years ago, but a few were recently collected in Trieste.

AVICULARIAN BODIES.

The avicularian glands are more pronounced in the *Lepralia foliacea* to which I referred in the Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 124, pl. xv. fig. 8, than in the 'Challenger' *Lepralia margaritifera*. A similar gland occurs in the vicarious avicularia of *Retepora cellulosa* from Naples, in which species there are also the suboral glands. In this case parenchym-threads at the base of the gland pass to a rosette plate, thus connecting the avicularian chamber with the next zoecium, and the other gland is joined in a similar way with another zoecium (Pl. XIX. fig. 14). Thus there is direct communication from the avicularium to two zoecia, and we find that these parenchym-threads pass to every organ of the Bryozoa.

* Vol. xxxi. pt. lxxix.

† For the sake of brevity I shall refer to these merely as "glands."

These bodies I have, however, been better able to study in *Lepralia foliacea*, where the position and shape of the avicularian chamber is similar to that of *L. margaritifera*. The avicularian chamber is very wide, in fact the full width of the zoecium, but the glands are nevertheless curved under or over at the extremity (Pl. XIX. fig. 5). The surface of the gland shows a distinct marking of a more or less wavy description (fig. 1, right hand), and when sections are cut through the wall it is seen to be composed of small elongate cells which are in some cases distinctly nucleated (fig. 13).

These glands or hollow bodies are not attached one to another directly, but to the sheath which contains what we must at present call the avicularian body, and this to me seems the most important part of the avicularium; but before passing to its description I would point out that the glands of the avicularium and the suboral glands are both attached to the respective sheaths, though in the suboral glands the attachment occurs at the distal end by the operculum.

To return to the avicularium: there are some points which have not been described, for though a cellular body in the avicularium has long been known it has not been always made clear how this occurs in a sheath probably to be looked upon as homologous with the sheath enclosing the tentacles of the polypide. I have not, however, been able in all specimens to distinguish an avicularian sheath. This is very clear in *Bicellaria moluccensis*, Busk, of the 'Challenger;' it can also be seen in *Diachoris magellanica*; and in the *Lepralia foliacea* under discussion it is easily seen. Inside the sheath hangs the cellular body, and in many avicularia this "peculiar" or "tactile body"* of Busk seems to be double. In *Diachoris magellanica*, Busk, although this "peculiar" body protrudes out of the avicularium in the same way as in *Bugula plumosa*, I did not see in the specimens of *D. magellanica* examined alive in Naples any setæ, though in *Bugula plumosa* † in Trieste they were easily recognized. I should, however, be glad to have the opportunity of again examining live *Diachoris* under favourable circumstances.

* "On Avicularia," &c., Quart. Journ. Mier. Sci. vol. ii. p. 26.

† In Trieste I noticed that with clean and healthy *Bugulæ*, out of the Aquarium, there was no frequent snapping of the mandibles; but on the other hand the whole articulated avicularium was constantly moving deliberately backwards and forwards with the beak open, and this was only rarely closed.

In *Onychocella angulosa* a chitinous ring surrounds the end of the "peculiar body," and there is something of the same kind in *Schizoporella unicornis*, this part protruding as a double tube. The avicularia of *Onychocella angulosa* and *Schizoporella linearis* are the largest I have examined, and in neither case is there a trace of a double gland. *Schizoporella linearis* has a large avicularian chamber on the front of the zoecium, but the cellular body is very small. This raised structure was thought by Hincks* to be an ovicell; but in my paper on the use of the mandibles I figured a mandible †, and have since been able to cut sections showing that the chamber contains nothing except the cellular body and the powerful muscles, which, from the shape of the chamber, are of course above the operculum. Dried specimens have also shown that the chamber could only be avicularian, and that the wall separating the avicularium from the zoecium is perforated.

SUBORAL GLANDS.

Glands have been mentioned by Ostroumoff, and Repiachoff speaks in 'Zur Naturgeschichte d. Chil. Seebryzoens,' p. 148, of two "blasenförmigen Gebilde" at each side of the operculum in *Lepralia Pallasiana*. Jullien ‡, since my Supplementary 'Challenger' Report was written, has described, as a testis, an organ on one side of *Microporella violacea*. According to Jullien this is not paired, but it has much the character of the paired organs. In my sections of *Microporella violacea* I find nothing of the kind, but it is only right to say that the material I had available was not very satisfactory.

I have them in *Schizoporella sanguinea* from Trieste and Naples occurring at any rate in the autumn and in mid-winter. In the Naples specimens I did not at first see any attachment of the lower end of the gland, but have since found it in some cases; and in some specimens from Trieste this attachment to the walls of the zoecium by means of parenchym-threads is more distinct. As there are similar threads from the end of the avicularian gland in *Retepora cellulosa*, this is of considerable interest.

* Brit. Mar. Polyzoa, p. 251.

† Journ. R. Mic. Soc. ser. 2, vol. v. p. 6, pl. xiv. fig. 8.

‡ "Du Testicle chez la *Lepralia figularis*," Mém. Soc. Zool. de France, vol. i. p. 270, pl. x. (1889).

The shape of the glands is subject to considerable change, no doubt depending both on age and activity of function; but when mature a constriction shows that they are divided into two parts, the terminal portion having much larger cells than the portion leading to the opercular opening.

In *Retepora cellulosa* there are frequently two glands on each side, as figured in my Supplementary 'Challenger' Report, pl. iii. fig. 13. The larger one seems to correspond with the glands in other species, and the difference in appearance makes it all the more difficult to understand what the function may be.

These glands are now known in a considerable number of species, for example in various *Reteporæ* and *Celleporæ*, *Lepralia Pallasiana*, *Smittia nitida* var. *ophidiana*, *Smittia bispinosa*, *Smittia trispinosa*, *Schizoporella sanguinea*, and *Microporella coriacea*.

Although thus occurring over a wide range, there are many others in which I have not found anything of the kind, but we should be alive to their sometimes having a somewhat different appearance, as can be seen from Pl. XIX. fig. 16.

In some zoœcia of *Smittia trispinosa* the gland has much the same form as in *Schizoporella sanguinea*, whereas in others it looks more like an oval or round body suspended by parenchym *

* In normal conditions in the Bryozoa this parenchym tissue is composed of a number of fine threads spreading through the zoœcia, but in abnormal or unhealthy conditions the appearance sometimes becomes more that of a solid cord, and I take it that the figures given by Reichert and copied by Hincks (Brit. Mar. Polyz. figs. xv. & xvii.) were taken from such specimens, for in Naples, when I examined live and recent specimens of *Zoobotryon pellucidum*, the "colonial nervous system" was always composed of numerous fine threads. These threads constantly anastomose, and in the Chilostomata not only pass to the neighbouring zoœcia, but also to all the organs, as avicularia, ovicells, ovaria, and testes.

The lower part of the cœcum is almost surrounded by this plasma, and from it numerous threads spread out. This has been described as a funicular platte, but in the specimens examined it is not a solid structure. This accumulation of plasma at the base of the cœcum suggests a simple explanation of the absorption of nourishment into the colony, which is, that as the digestion principally takes place in the cœcum the plasma absorbs the results of digestion, and so by the constant changes going on in the parenchym threads the digested nourishment is conveyed to all parts of the body. When a polypide is unable to obtain a full supply of nourishment, the organic contents of the cœcum being absorbed, the portion remaining consists of the undigestible diatoms &c., and this soon forms the brown body. The form of these parenchym threads is constantly undergoing change through the whole of the zoœcium.

and contractile tissue (fig. 16). Then, again, in *Smittia ophidiana* (fig. 15) the gland is as usual attached where the sheath joins the zoëcial wall, but below it is fastened to the sheath and not to the zoëcial wall.

Since writing the above I have obtained Harmer's suggestive paper* "On the Nature of Excretory Processes in Marine Polyzoa," dealing with leucocytes and other cells. As many of my slides bear interestingly on the subject I shall have to return to the study of this point. However, if cells which wander about in the zoëcium become part of an encysted mass, as a "brown body" which may or may not (perhaps after weeks or months) be removed from the zoëcium, ought we to compare this with ordinary excretory processes?

MEDIAN BODY.

In *Schizoporella sanguinea* there is another problematic structure which should certainly be studied in connexion with these glands, as it arises very near to them, if not from the same tissues. It hangs down from the opercular region, and when fully grown is sausage-shaped, and ultimately may be said to be suspended by a thin cord. This commences near the opercular opening, at first simply as a projection of the tissue, afterwards forming a thin lancet-like pendant, which gradually increases in thickness. Of course in all these calcareous species it will never be possible to follow the growth of any individual, and it is only by seeing a considerable series in decalcified preparations and sections that the growth can be worked out.

The whole body is surrounded by a membrane, and in the contents there are irregular-shaped strongly refractive masses, which appear homogeneous and do not stain (Pl. XIX. figs. 9-12). Round each of these refractive masses there is a clear space, and the general appearance of the whole structure would suggest that it is connected with reproduction, and we must ask whether it is to be compared with seasonal eggs. There is sometimes an ovarium in the same zoëcium as these sausage-like bodies.

In *Diachoris magellanica*, Busk, the so-called eggs (Jullien) have at the commencement a minute structure similar to that of the sausage-shaped bodies in *Schizoporella sanguinea*.

* Micro. Journ. vol. xxxiii. n. s. p. 123.

There are both ovaries and testes in the same zoëcia with these so-called eggs. It may be that there are two different kinds of reproduction in the *Gymnolæmata* as well as in *Phylactolæmata*.

Although, so far as I am aware, the way in which these sausage-shaped bodies grow has no parallel in other species, yet other growths should be studied to see whether they can throw light upon this. In nearly all species budding takes place close to the operculum, though in many works buds are stated to arise from the proximal wall of the zoëcium. It is true that this is the case in some, but not all, species of *Flustra*, and no doubt budding has been more often examined in this genus than in those which are more concealed by the calcareous covering. In cases where the budding is from the proximal end I have noticed that there is a great development of parenchym in the distal end of the next older zoëcium, and this leads up to the distal rosette-plate, giving the bud the appearance of starting from the rosette-plate.

In *Adeonella polystomella*, Reuss, there is a small round body so close to the operculum that it seems attached to it. The parenchym comes up to and sometimes partly surrounds it, and from this part the buds arise.

It would seem that reproduction takes place in the Bryozoa in more ways than has been commonly supposed, as there is considerable difference in the early division of the ova and in the stage in which the ovum passes into the ovicell, and in many cases the larva develops in an internal chamber divided off from the rest of the zoëcium, and not in an external ovicell.

In *Caberea Boryi*, Aud., the ovarium occurs near the distal end of the zoëcium, and close to it there is in most cases an oval body surrounded by a relatively thick cover which looks as though it were chitinous, though, as it stains, this is probably not the case.

The contents appear homogeneous; and here we may again ask whether this is a seasonal egg. There are, of course, also ova and larvæ in the ovicells of this species.

EXPLANATION OF PLATE XIX.

- Fig. 1. Section through the avicularian chamber of *Lepralia foliacea*, Ell. & Sol. *m*, mandible; *g*, gland-like bodies, the left one is shown in section, the right-hand one shows the surface; *c*, "cellular body." $\times 250$.
2. Longitudinal section of the avicularian chamber of *Lepralia foliacea* cutting through the gland-like body. $\times 250$.
3. Avicularium of *Bicellaria moluccensis*, Busk.—*m*, &c. as above. $\times 125$.
4. Section of zoecium of *Lepralia foliacea* showing the avicularian chamber *in situ*. The polypide is given in order that the relative position may be better understood, and although the different parts are drawn somewhat diagrammatically, all are taken from actual specimens. The sacs are shown in section. $\times 85$.
5. Avicularian chamber of *Lepralia foliacea*. $\times 85$.
6. Gland-like body of *Schizoporella sanguinea*, Norm. $\times 500$.
7. Operculum and distal end of *Schizoporella sanguinea*. The gland-like bodies are shown in section. $\times 85$.
8. Ditto, showing (*a*) growth from tissue at the opercular end. The right gland-like body is shown in section and with an attachment to the zoecial wall. $\times 85$.
9. The prolongation of this tissue has now grown into the median body (*s*), which lies diagonally across the upper part of the zoecium. $\times 85$.
10. Ditto. (*s*) hangs from the centre attached merely by a fine cord. $\times 85$.
11. Longitudinal section of a median body from *Schizoporella sanguinea*, showing the refracting masses. $\times 250$.
12. Ditto. Transverse section. $\times 250$.
13. Nucleated cells of gland of *Schizoporella sanguinea*. $\times 500$.
14. Section of *Retepora cellulosa*, L., showing vicarious avicularia with gland-like bodies. Each avicularium is connected through rosette-plates to two zoecia. $\times 85$.
15. Distal end of *Smittia nitida*, var. *ophidiana*, Waters. $\times 85$.
16. Distal end of *Smittia trispinosa*, Johnst. $\times 85$.
-

